

LM78LXX Series 3-Terminal Positive Regulators

General Description

The LM78LXX series of three terminal positive regulators is available with several fixed output voltages making them useful in a wide range of applications. When used as a zener diode/resistor combination replacement, the LM78LXX usually results in an effective output impedance improvement of two orders of magnitude, and lower quiescent current. These regulators can provide local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow the LM78LXX to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment.

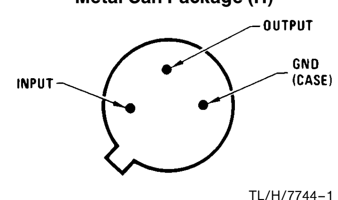
The LM78LXX is available in the metal three-lead TO-39(H) package, the plastic TO-92 (Z) package, and the plastic SO-8 (M) package. With adequate heat sinking the regulator can deliver 100 mA output current. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistors is provided to limit internal power dissipation. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating.

Features

- Output voltage tolerances of ±5% (LM78LXXAC) over the temperature range
- Output current of 100 mA
- Internal thermal overload protection
- Output transistor safe area protection
- Internal short circuit current limit
- Available in plastic TO-92 and metal TO-39 and plastic SO-8 low profile packages
- No external components
- Output voltages of 5.0V, 6.2V, 8.2V, 9.0V, 12V, 15V

Connection Diagrams



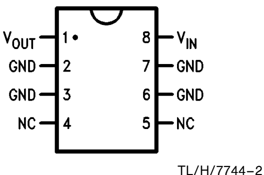


TL/H/7744–1

Bottom View

Order Number LM78L05ACH, LM78L12ACH or LM78L15ACH
See NS Package Number H03A

SO-8 Plastic (M) (Narrow Body)

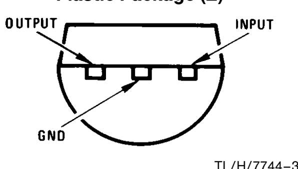


TL/H/7744–2

Top View

Order Number LM78L05ACM, LM78L12ACM or LM78L15ACM
See NS Package Number M08A

(TO-92) Plastic Package (Z)



TL/H/7744–3

Bottom View

Order Number LM78L05ACZ, LM78L09ACZ, LM78L12ACZ, LM78L15ACZ, LM78L62ACZ or LM78L82ACZ
See NS Package Number Z03A

 RRD-B30M115/Printed in U. S. A.

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Power Dissipation (Note 5)	Internally Limited
Input Voltage	35V
Storage Temperature	−65°C to +150°C
Operating Junction Temperature	0°C to +125°C
Lead Temperature (Soldering, 10 seconds)	265°C
ESD Susceptibility (Note 2)	2 kV

LM78LXXAC Electrical Characteristics

Limits in standard typeface are for $T_J = 25°C$, **bold typeface applies over the 0°C to +125°C temperature range.** Limits are guaranteed by production testing or correlation techniques using standard Statistical Quality Control (SQC) methods. Unless otherwise specified: $I_O = 40$ mA, $C_I = 0.33$ μF, $C_O = 0.1$ μF.

LM78L05AC Unless otherwise specified, $V_{IN} = 10V$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		4.8	5	5.2	V
		$7V \leq V_{IN} \leq 20V$ $1 mA \leq I_O \leq 40 mA$ (Note 3)	**4.75**		**5.25**	
		$1 mA \leq I_O \leq 70 mA$ (Note 3)	**4.75**		**5.25**	
ΔV_O	Line Regulation	$7V \leq V_{IN} \leq 20V$		18	75	mV
		$8V \leq V_{IN} \leq 20V$		10	54	
ΔV_O	Load Regulation	$1 mA \leq I_O \leq 100 mA$		20	60	
		$1 mA \leq I_O \leq 40 mA$		5	30	
I_Q	Quiescent Current			3	5	mA
ΔI_Q	Quiescent Current Change	$8V \leq V_{IN} \leq 20V$			**1.0**	
		$1 mA \leq I_O \leq 40 mA$			**0.1**	
V_n	Output Noise Voltage	f = 10 Hz to 100 kHz (Note 4)		40		μV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz $8V \leq V_{IN} \leq 16V$	47	62		dB
I_{PK}	Peak Output Current			140		mA
$\frac{\Delta V_O}{\Delta T}$	Average Output Voltage Tempco	$I_O = 5$ mA		−0.65		mV/°C
V_{IN} (Min)	Minimum Value of Input Voltage Required to Maintain Line Regulation			6.7	7	V

LM78LXXAC Electrical Characteristics

Limits in standard typeface are for $T_J = 25°C$, **bold typeface applies over the 0°C to +125°C temperature range.** Limits are guaranteed by production testing or correlation techniques using standard Statistical Quality Control (SQC) methods. Unless otherwise specified: $I_O = 40$ mA, $C_I = 0.33$ μF, $C_O = 0.1$ μF. (Continued)

LM78L62AC Unless otherwise specified, $V_{IN} = 12V$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		5.95	6.2	6.45	V
		$8.5V \le V_{IN} \le 20V$ $1 mA \le I_O \le 40 mA$ (Note 3)	**5.9**		**6.5**	
		$1 mA \le I_O \le 70 mA$ (Note 3)	**5.9**		**6.5**	
ΔV_O	Line Regulation	$8.5V \le V_{IN} \le 20V$		65	175	mV
		$9V \le V_{IN} \le 20V$		55	125	
ΔV_O	Load Regulation	$1 mA \le I_O \le 100 mA$		13	80	
		$1 mA \le I_O \le 40 mA$		6	40	
I_Q	Quiescent Current			2	5.5	mA
ΔI_Q	Quiescent Current Change	$8V \le V_{IN} \le 20V$			**1.5**	
		$1 mA \le I_O \le 40 mA$			**0.1**	
V_n	Output Noise Voltage	f = 10 Hz to 100 kHz (Note 4)		50		μV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz $10V \le V_{IN} \le 20V$	40	46		dB
I_{PK}	Peak Output Current			140		mA
$\frac{\Delta V_O}{\Delta T}$	Average Output Voltage Tempco	$I_O = 5 mA$		−0.75		mV/°C
V_{IN} (Min)	Minimum Value of Input Voltage Required to Maintain Line Regulation			7.9		V

LM78LXXAC Electrical Characteristics

Limits in standard typeface are for $T_J = 25°C$, **bold typeface applies over the 0°C to +125°C temperature range.** Limits are guaranteed by production testing or correlation techniques using standard Statistical Quality Control (SQC) methods. Unless otherwise specified: $I_O = 40$ mA, $C_I = 0.33$ μF, $C_O = 0.1$ μF. (Continued)

LM78L82AC Unless otherwise specified, $V_{IN} = 14V$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		7.87	8.2	8.53	V
		$11V \leq V_{IN} \leq 23V$ $1 mA \leq I_O \leq 40 mA$ (Note 3)	**7.8**		**8.6**	
		$1 mA \leq I_O \leq 70 mA$ (Note 3)	**7.8**		**8.6**	
ΔV_O	Line Regulation	$11V \leq V_{IN} \leq 23V$		80	175	mV
		$12V \leq V_{IN} \leq 23V$		70	125	
ΔV_O	Load Regulation	$1 mA \leq I_O \leq 100 mA$		15	80	
		$1 mA \leq I_O \leq 40 mA$		8	40	
I_Q	Quiescent Current			2	5.5	mA
ΔI_Q	Quiescent Current Change	$12V \leq V_{IN} \leq 23V$			**1.5**	
		$1 mA \leq I_O \leq 40 mA$			**0.1**	
V_n	Output Noise Voltage	f = 10 Hz to 100 kHz (Note 4)		60		μV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz $12V \leq V_{IN} \leq 22V$	39	45		dB
I_{PK}	Peak Output Current			140		mA
$\frac{\Delta V_O}{\Delta T}$	Average Output Voltage Tempco	$I_O = 5$ mA		−0.8		mV/°C
V_{IN} (Min)	Minimum Value of Input Voltage Required to Maintain Line Regulation			9.9		V

LM78LXXAC Electrical Characteristics

Limits in standard typeface are for $T_J = 25°C$, **bold typeface applies over the 0°C to +125°C temperature range.** Limits are guaranteed by production testing or correlation techniques using standard Statistical Quality Control (SQC) methods. Unless otherwise specified: $I_O = 40$ mA, $C_I = 0.33$ μF, $C_O = 0.1$ μF. (Continued)

LM78L09AC Unless otherwise specified, $V_{IN} = 15V$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		8.64	9.0	9.36	V
		$11.5V \le V_{IN} \le 24V$ $1\ mA \le I_O \le 40\ mA$ (Note 3)	**8.55**		**9.45**	
		$1\ mA \le I_O \le 70\ mA$ (Note 3)	**8.55**		**9.45**	
ΔV_O	Line Regulation	$11.5V \le V_{IN} \le 24V$		100	200	mV
		$13V \le V_{IN} \le 24V$		90	150	
ΔV_O	Load Regulation	$1\ mA \le I_O \le 100\ mA$		20	90	
		$1\ mA \le I_O \le 40\ mA$		10	45	
I_Q	Quiescent Current			2	5.5	mA
ΔI_Q	Quiescent Current Change	$11.5V \le V_{IN} \le 24V$			**1.5**	
		$1\ mA \le I_O \le 40\ mA$			**0.1**	
V_n	Output Noise Voltage			70		μV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz $15V \le V_{IN} \le 25V$	38	44		dB
I_{PK}	Peak Output Current			140		mA
$\frac{\Delta V_O}{\Delta T}$	Average Output Voltage Tempco	$I_O = 5\ mA$		−0.9		mV/°C
V_{IN} (Min)	Minimum Value of Input Voltage Required to Maintain Line Regulation			10.7		V

LM78LXXAC Electrical Characteristics

Limits in standard typeface are for $T_J = 25°C$, **bold typeface applies over the 0°C to + 125°C temperature range.** Limits are guaranteed by production testing or correlation techniques using standard Statistical Quality Control (SQC) methods. Unless otherwise specified: $I_O = 40$ mA, $C_I = 0.33\ \mu F$, $C_O = 0.1\ \mu F$. (Continued)

LM78L12AC Unless otherwise specified, $V_{IN} = 19V$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		11.5	12	12.5	V
		$14.5V \le V_{IN} \le 27V$ $1\ mA \le I_O \le 40\ mA$ (Note 3)	**11.4**		**12.6**	
		$1\ mA \le I_O \le 70\ mA$ (Note 3)	**11.4**		**12.6**	
ΔV_O	Line Regulation	$14.5V \le V_{IN} \le 27V$		30	180	mV
		$16V \le V_{IN} \le 27V$		20	110	
ΔV_O	Load Regulation	$1\ mA \le I_O \le 100\ mA$		30	100	
		$1\ mA \le I_O \le 40\ mA$		10	50	
I_Q	Quiescent Current			3	5	mA
ΔI_Q	Quiescent Current Change	$16V \le V_{IN} \le 27V$			**1**	
		$1\ mA \le I_O \le 40\ mA$			**0.1**	
V_n	Output Noise Voltage			80		μV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz $15V \le V_{IN} \le 25V$	40	54		dB
I_{PK}	Peak Output Current			140		mA
$\frac{\Delta V_O}{\Delta T}$	Average Output Voltage Tempco	$I_O = 5\ mA$		−1.0		mV/°C
V_{IN} (Min)	Minimum Value of Input Voltage Required to Maintain Line Regulation			13.7	14.5	V

LM78LXXAC Electrical Characteristics

Limits in standard typeface are for $T_J = 25°C$, **bold typeface applies over the 0°C to +125°C temperature range.** Limits are guaranteed by production testing or correlation techniques using standard Statistical Quality Control (SQC) methods. Unless otherwise specified: $I_O = 40$ mA, $C_I = 0.33$ µF, $C_O = 0.1$ µF. (Continued)

LM78L15AC Unless otherwise specified, $V_{IN} = 23V$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		14.4	15.0	15.6	V
		$17.5V \le V_{IN} \le 30V$ $1 mA \le I_O \le 40 mA$ (Note 3)	**14.25**		**15.75**	
		$1 mA \le I_O \le 70 mA$ (Note 3)	**14.25**		**15.75**	
ΔV_O	Line Regulation	$17.5V \le V_{IN} \le 30V$		37	250	mV
		$20V \le V_{IN} \le 30V$		25	140	
ΔV_O	Load Regulation	$1 mA \le I_O \le 100 mA$		35	150	
		$1 mA \le I_O \le 40 mA$		12	75	
I_Q	Quiescent Current			3	5	mA
ΔI_Q	Quiescent Current Change	$20V \le V_{IN} \le 30V$			**1**	
		$1 mA \le I_O \le 40 mA$			**0.1**	
V_n	Output Noise Voltage			90		µV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz $18.5V \le V_{IN} \le 28.5V$	37	51		dB
I_{PK}	Peak Output Current			140		mA
$\frac{\Delta V_O}{\Delta T}$	Average Output Voltage Tempco	$I_O = 5$ mA		−1.3		mV/°C
V_{IN} (Min)	Minimum Value of Input Voltage Required to Maintain Line Regulation			16.7	17.5	V

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Electrical specifications do not apply when operating the device outside of its stated operating conditions.

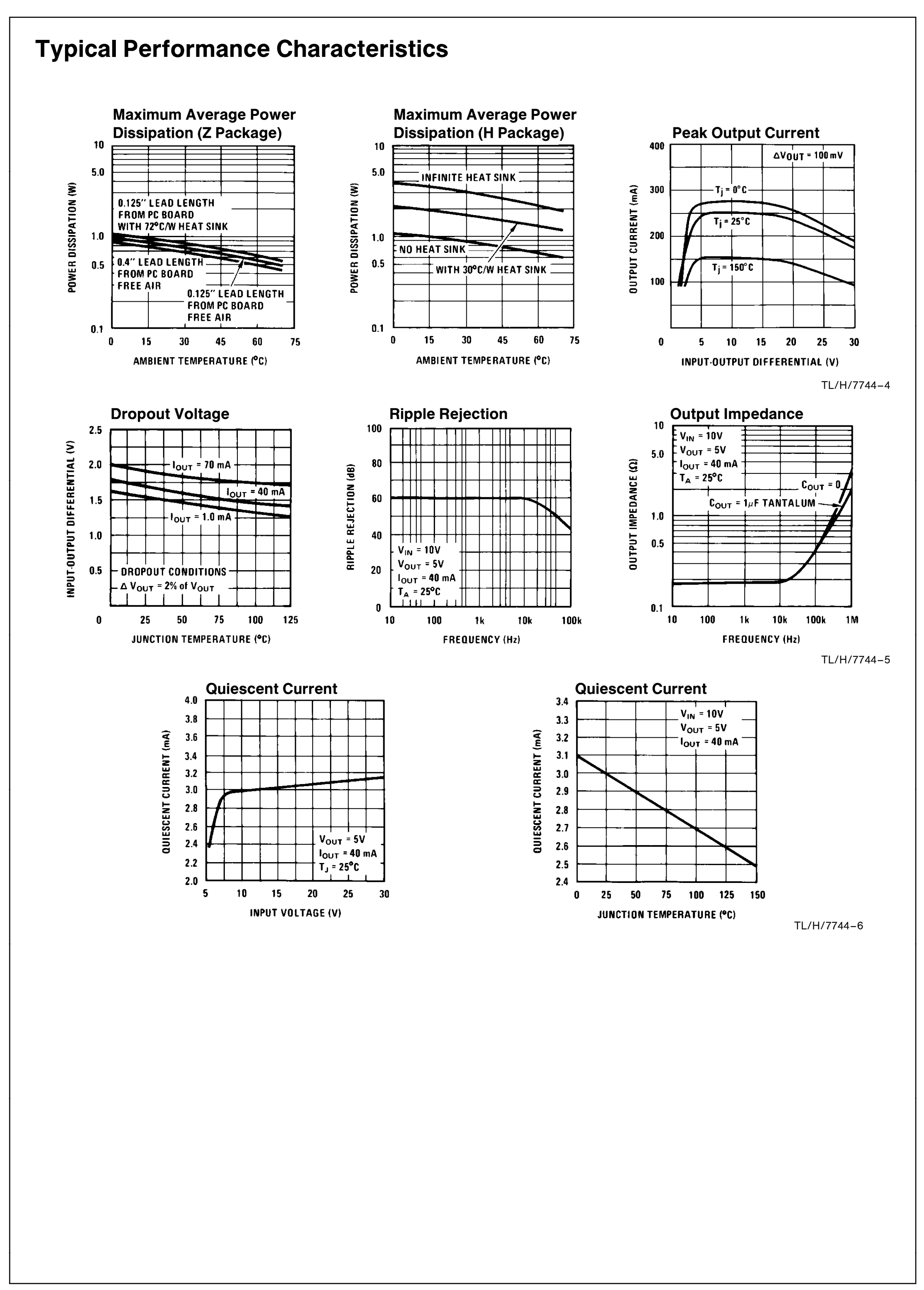
Note 2: Human body model, 1.5 kΩ in series with 100 pF.

Note 3: Power dissipation ≤ 0.75W.

Note 4: Recommended minimum load capacitance of 0.01 µF to limit high frequency noise.

Note 5: Typical thermal resistance values for the packages are:
H Package: Rth(J-C) = 26 °C/W, Rth(J-A) = 120 °C/W
Z Package: Rth(J-C) = 60 °C/W, Rth(J-A) = 230 °C/W
M Package: Rth(J-A) = 180 °C/W

Typical Performance Characteristics



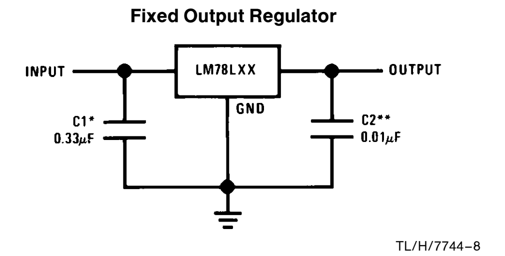
Equivalent Circuit

LM78LXX

TL/H/7744–7

Typical Applications

Fixed Output Regulator

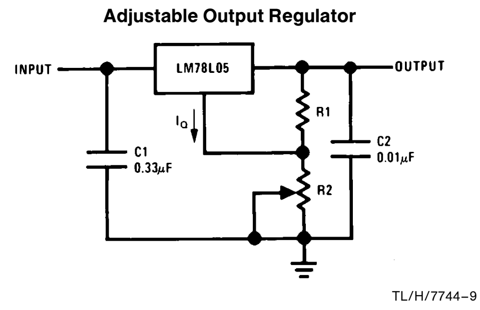


TL/H/7744–8

*Required if the regulator is located more than 3″ from the power supply filter.

**See Note 4 in the electrical characteristics table.

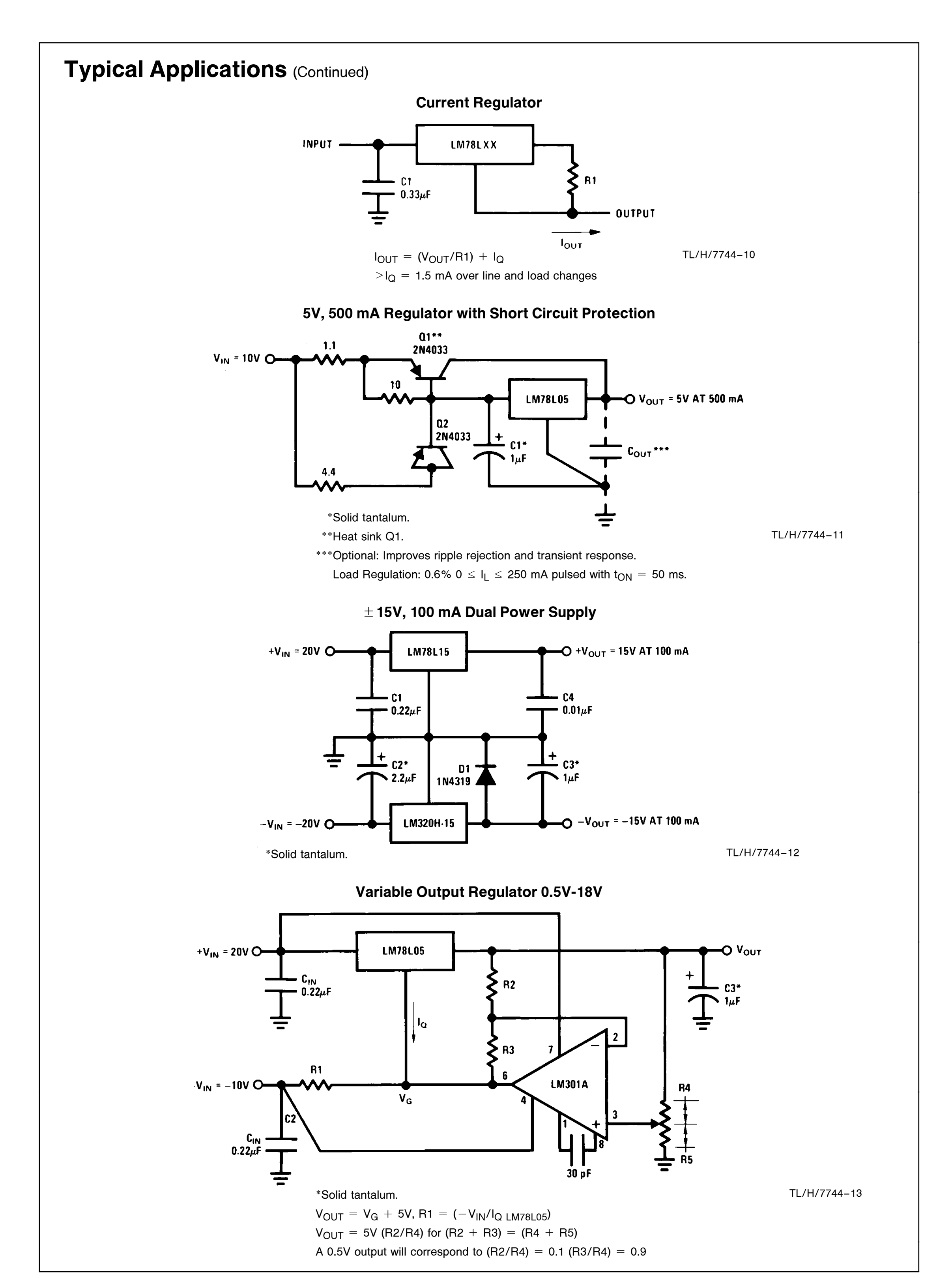
Adjustable Output Regulator



TL/H/7744–9

$V_{OUT} = 5V + (5V/R1 + I_Q) R2$

$5V/R1 > 3 I_Q$, load regulation (L_r) $\approx$ [(R1 + R2)/R1] (L_r of LM78L05)



$I_{OUT} = (V_{OUT}/R1) + I_Q$

$> I_Q = 1.5$ mA over line and load changes

TL/H/7744–10

*Solid tantalum.

**Heat sink Q1.

***Optional: Improves ripple rejection and transient response.

Load Regulation: 0.6% $0 \leq I_L \leq 250$ mA pulsed with $t_{ON} = 50$ ms.

TL/H/7744–11

*Solid tantalum.

TL/H/7744–12

*Solid tantalum.

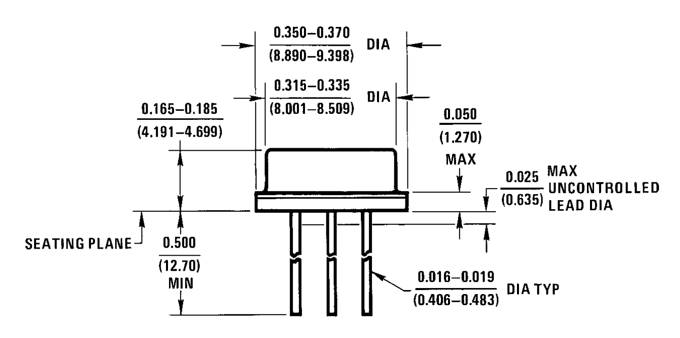
$V_{OUT} = V_G + 5V$, $R1 = (-V_{IN}/I_{Q\ LM78L05})$

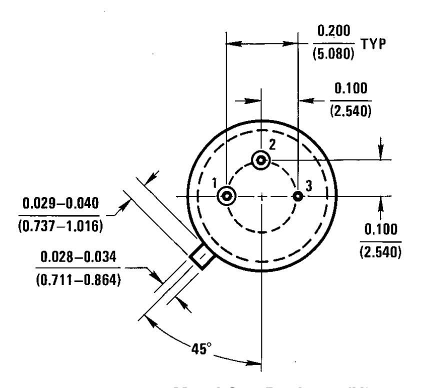
$V_{OUT} = 5V\ (R2/R4)$ for $(R2 + R3) = (R4 + R5)$

A 0.5V output will correspond to $(R2/R4) = 0.1$ $(R3/R4) = 0.9$

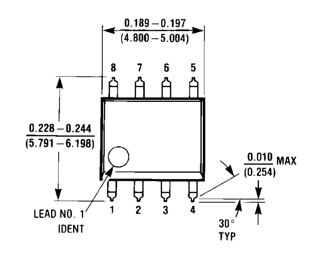
TL/H/7744–13

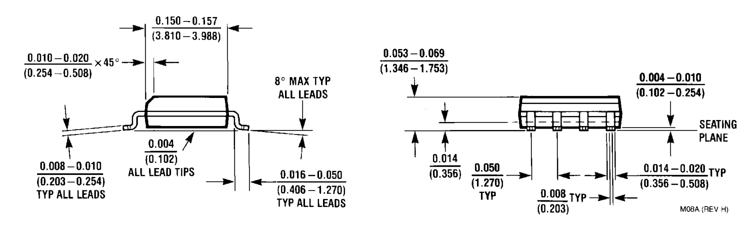
Physical Dimensions inches (millimeters)





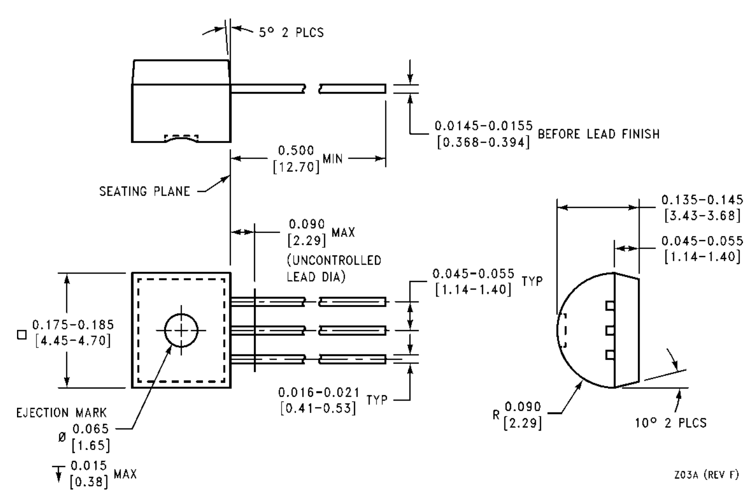
Metal Can Package (H)
Order Number LM78L05ACH, LM78L12ACH or LM78L15ACH
NS Package Number H03A





S.O. Package (M)
Order Number LM78L05ACM, LM78L12ACM or LM78L15ACM
NS Package Number M08A

Physical Dimensions inches (millimeters) (Continued)



Molded Offset TO-92 (Z)
Order Number LM78L05ACZ, LM78L09ACZ, LM78L62ACZ, LM78L82ACZ, LM78L12ACZ or LM78L15ACZ
NS Package Number Z03A



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